Biogas Facilities HRA 2020 - 2021

Summary Report

Simtars
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1 Introduction

At the request of the Queensland Petroleum and Gas Inspectorate, a Simtars Principal Occupational Hygienist conducted a walkthrough survey and qualitative health risk assessment (HRA) of four (4) Queensland biogas facilities between August 2020 and April 2021.

The purpose of the HRA's was to identify occupational health and hygiene exposure risks, and to provide a qualitative risk ranking of the exposures with consideration to the following:

- specific exposures or issues identified previously of particular concern to workers
- details of hazardous materials used
- numbers of workers normally assigned to an operational area or work group
- shift length and roster rotation details
- general indications of time spent by worker/s undertaking particular tasks and how often the work is performed
- the locations of suspected hazard emission points
- personal protective equipment available for use
- the types of control measures currently in place and their observed effectiveness.

2 Occupational Hygiene Hazards

The common exposures identified during the survey's included the following hazards.

2.1 Noise

Noise exposure was typically from gas powered generators. The estimated noise levels ranged from ~75dBA external to generator sets such as the Jenbacher shown in Photo 1 to in excess of 85dBA for the backup generators in open areas (Photo 2).

Photo 1: GE Jenbacher gas powered generator.

Photo 2: Open air backup generator

The internal surfaces of the generator enclosures are covered in a thermal acoustic panel to reduce noise transmission during operation (Photo 3). With the doors open, Simtars estimates the noise levels to be approximately 80 – 85 dBA, (Photo 4). For the enclosures that do not have roof mounted engine cooling systems, the doors are left open to reduce the heat load on the engines. Unfortunately, this increases the risk of noise exposure to the workforce, with an increased reliance on the use of hearing protective equipment (e.g. plugs, muffs etc) to protect or prevent noise induced hearing loss (NIHL).

Photo 3: Thermo-acoustic panels / doors in the generator enclosure.

Photo 4: Generator enclosures open, to assist with cooling of the engines in hotter months.

To select the correct type of hearing protection, an area noise survey should be conducted to confirm the actual noise levels in and around the generators during normal operation. The results of the area noise survey should be compared against the occupational exposure limits $L_{Aeq,8hr}$ exposure limit of 85 dBA and the L_{Cpeak} exposure limit of 140 dBC. The survey will assist the operators in identifying locations that should be treated as mandatory hearing protection zones with the results shown on an area noise map.

The area noise survey will serve two purposes.

1) determine the boundary at which hearing protection is required prior to entering the facility
2) assist in selecting hearing protection type (e.g., ear plugs and / or ear muffs) with the appropriate hearing protection rating.

Consideration should be given to posting a mandatory hearing protection sign at the entrances to the generator areas stating the noise level (e.g. 93dBA), and the class of hearing protection required (e.g. Class 2).

2.1.1 Hearing Protective Devices (HPD)

When selecting HPD, workers should be consulted and offered a range of suitable styles to try. This will help increase the likelihood of compliance if workers have a choice of equipment that is comfortable for them to use. These recommendations are based on protecting workers against noise induced hearing loss (NIHL) without over-protection and considers the potential for workers not to have hearing protection correctly fitted to 100% attenuation value.

Overprotection of workers (i.e., wearing Class 5 hearing protection in areas where a lower class is sufficient) should be avoided. Overprotection may:

- create a sense of isolation for the worker
- make it difficult to hear radio commands and / or alarms
- potentially lead to workers removing hearing protection to communicate
- tendency for operators of equipment to increase the volume of radios when wearing higher rated hearing protection than required.

2.1.2 Audiometric Testing

Audiometric testing is an essential part of a formal hearing protection and management program. The Workplace Health and Safety 2021 Code of Practice (COP) *Managing Noise and Preventing Hearing Loss at Work* (1) recommends that personnel exposed to noise at a workplace should undergo audiometric testing. Specifically,

"*Starting the audiometric testing before people are exposed to hazardous noise (such as new starters or those changing jobs) provides a baseline as a reference for future audiometric test results. To be effective, initial audiometric testing should be provided within three months of the worker commencing work with regular follow-up tests at least every two years. These should be undertaken well into the work shift so that any temporary*

hearing loss can be picked up. More frequent audiometric testing (e.g., every six months) may be needed if exposures are at a high LAeq,8h, which is equal or greater than 100 dB(A)".

2.2 Thermal / UV Radiation

2.2.1 Heat Related Illnesses

Exposure to high ambient heat levels is a frequent occurrence for all the biogas facilities inspected. Discussion with site personnel suggests that there is an appreciable level of awareness with regards to thermal heat exposure and symptom recognition, though in some cases no formal heat stress policy or program could be identified.

Where appropriate, heat exposure should be risk assessed using an appropriate methodology, such as the Australian Institute of Occupational Hygienists (AIOH) "Guide to Managing Heat Stress" (2). The AIOH document should be considered when determining possible "triggers" for assessment. Where possible, high intensity work should be scheduled during cooler parts of the day, particularly for workers not acclimatised to the ambient conditions or work routines.

2.2.2 UV Radiation Exposure and Skin Checks

The safety clothing such as high-vis long sleeved shirts, long trousers, hats provides an element of protection against the harmful effects of UV radiation from the sun. SPF50+ sunscreen was available for use at the majority of the facilities and its regular application should be encouraged to provide UV protection for the face and neck.

Consideration should be given to the inclusion of regular skin checks for workers required to spend prolonged periods in the sun as part of the site health surveillance program. The Cancer Council's position statement on early detection of skin cancer (3) '*recommends that people consult their doctor if they notice any changes to their skin. Full skin examinations supported by total body photography and dermoscopy are also recommended every 6 months for individuals at high risk'*.

2.3 Hazardous Chemicals

2.3.1 Spills Containment, Storage and 'Bunds'

Hazardous chemicals hazards were generally limited to the storage, use and handling of bulk lubricants and engine coolants used for the service and maintenance of the gas powered generators, and bulk above ground tanks for diesel backup generators.

Spill containment is required for any bulk storage of flammable and combustible liquids in accordance with the Australian Standard AS1940 (4). Section 5.8.1 (Bunds and Compounds) states that provision shall be made to prevent any spill or leak from flammable or combustible storage from contaminating the ground, entering a watercourse or a water drainage system. This is particularly important for above ground bulk diesel storage tanks as shown in Photo 5.

Photo 5: Bulk above ground tanks for diesel backup generators

Photo 6: portable bund for a 1,000L IBC.

The same principal applies for the holding of bulk waste chemicals / lubricants in intermediate bulk containers (IBC's) as shown in Photo 6. Section 5.8.2 of AS1940 states that the net capacity of the bund should be at least 110% of the capacity of the largest tank in the compound, or 25% of the total capacity, whichever is the greater.

AS1940 Section 4.4.3 (4) states that provision shall be made to contain leaks or spillages, and to prevent the spills from causing environmental damage. The standard states that portable bunded pallets are suitable for *short-term holding of the chemicals*, as there is no uniform chemical or fire resistance criteria applicable to their construction, and that they can be readily moved to an incompatible storage location near a heat, fire or ignition source.

The alternate to bunded storage of bulk chemicals is using a container with an integral secondary containment and plumbing the lubricants / fuels directly into the engine lubricating or fuel systems. An example of such a container is shown in Photo 7.

Photo 7: Bulk fresh engine oil storage with integral secondary containment.

Figure 1: Sodium hydroxide (NaOH) emergency information placard.

At one facility, two IBC's containing sodium hydroxide (NaOH) were stored near an injection manifold for the return water line to the anaerobic digester. NaOH is used for pH balance when the return water shows a low pH (i.e., slightly acidic). The NaOH is used rarely, and may take months to consume the full 1,000L available. Quantities greater than and equal to 1,000L for a Class 8 Corrosive require an information placard posted to the location visible from the normal approaches (5).

2.4 Gas Detection

2.4.1 Personal gas detectors, OEL and alarm set limits

Biogas facility operators need to be aware that the typical alarm set limits for a personal gas detector may be at, or above the applicable occupational exposure limit (OEL). An occupational exposure limit (OEL) is the airborne concentration of a particular substance or mixture that must not be exceeded. For example, the non-latching low level alarm for carbon monoxide (CO) is at the time weighted average (TWA) of 30 ppm, and the high level latching alarm is twice that limit. Similarly, the low level alarm for H_2S is at the TWA of 10 ppm, with the high level alarm above the Short Term Exposure Limit (STEL) of 15 ppm.

Table 1 – Alarm Set Limits as compared to the OEL

Gas Detector	Low Level Alarm	High Level Alarm	Time Weighted Average (OEL)	Short Term Exposure Limit (OEL)
Methane (CH_4)	5% LEL	10% LEL	n/a	n/a
Oxygen (O_2)	19.5%	23.5%	n/a	n/a
Carbon monoxide (CO)	30 ppm	60 ppm	30 ppm	n/a
Hydrogen sulphide (H_2S)	10 ppm	20 ppm	10 ppm	15 ppm

It is important to understand that the OEL does not represent an acceptable level of exposure for workers, instead they are the maximum upper limit imposed by Legislation. For this reason, airborne exposures should be kept as low as reasonably achievable in order to minimise the health risk to workers.

2.4.2 Personal Gas detector calibration

Section 11.1 *Maintenance, routine procedures, and general administrative control* of AS/NZS 60079.29.2 (6) states that gas detection equipment should be tested / recalibrated in accordance with the manufacturer's instructions. In essence, the sensors should be subjected to an in-field, full scale 'gas challenge test' and the sensor's response (including the alarm response) should be recorded in a maintenance database for trends analysis.

Technically, this is a single point span test or 'bump' test, and does not meet the standard for laboratory calibration as per Section 4.7 (Calibration) of the Australian and New Zealand Standard AS/NZS 2290.3 (7), or the guidance stated in the Petroleum and Gas Inspectorate Safety Alert no. 70 (8) *'Importance of gas detection equipment maintenance and calibration'* issued 23 November 2016.

Industry is advised to ensure that their personal gas detectors are calibrated at an accredited test authority every 6 months in accordance AS/NZS 2290.3 and the Petroleum and Gas Inspectorate Safety Alert 70. Safety Alert no. 70 also makes the following recommendations:

1) Equipment should be checked daily to ensure that it is clean, fully charged and in good working condition. That's is, no sign of damage to the screen of case integrity, sensor filters not clogged, rubber seals intact, etc.
2) Conduct regular 'bump' tests of the gas detector by exposing the sensors to a certified test gas containing contaminants at least 90% of the intended alarm set limit of the instrument. It is advised that the 'bump' test be conducted on the day before use and must include a fresh air zero of the sensors in accordance with the manufacturer's instructions.
3) Ensure that all workers who use (or are likely to use) the personal gas detectors are appropriately trained in the safe operation service and in-field maintenance of the gas detectors in accordance with the manufacturer's recommendations.
4) Records of the daily inspections, results from the 'bump' test, calibration and test gas certificates are to be held and readily available for inspection.

2.4.3 Fixed gas sensor calibration

AS/NZS 60079.29.1 suggests that the sensor performance tests should be conducted weekly on a new sensor installation, then monthly based on the performance / stability of the sensors. If the sensor readings trend outside of the manufacturer's allowable tolerance, the sensors should be re-calibrated against at least three gas concentrations / alarm trigger points (zero gas, half scale and full scale) to demonstrate a linear response. Ideally this should be done by the manufacturer, or manufacturer's representative ideally quality accredited by NATA.

2.5 Biological

There exists an elevated risk of contracting Q fever from abattoir and animal wastes, and adjoining cattle yards, pens and processing areas. Q Fever is an illness caused by breathing in droplets or dust contaminated by birth fluids, faeces, or urine from variety of infected domestic and wild animal species (e.g., cattle, sheep, goats, and kangaroos) that carry the *Coxiella burnetii* bacteria. The bacteria can survive in dust and soil for months and years, even when the animals are no longer present.

Q fever is usually an acute (immediate) infection, but sometimes it can lead to a chronic (long-term) illness. Spread of the Q fever infection from person-to-person is rare and can be treated with antibiotics. Consideration should be given to a mandatory Q Fever vaccination program for workers (including service contractors and operators) and implementing a preventative measures program (e.g., face masks, hand washing, controlled plant entry) for visitors who cannot provide documentary evidence of having received the vaccine.

Detailed advice of the disease and prevention measures (including vaccination) can be sourced from http://conditions.health.qld.gov.au/HealthCondition/media/pdf/14/33/116/q-fever-v11

3 Recommendations

The following general recommendations are offered for consideration and action as necessary.

- Conduct an area noise survey in and around gas powered generator facilities and then compare the results against the occupational exposure limits $L_{Aeq,8hr}$ exposure limit of 85 dBA and the L_{Cpeak} exposure limit of 140 dBC. The results should be posted on an area noise map, stating which areas are mandatory hearing protection zones.
- Consideration should be given to posting a mandatory hearing protection sign at the entrances to the generator areas stating the noise level (e.g. 93dBA), and the class of hearing protection required (e.g. Class 4).
- Implement a formal noise and hearing protection management program, which includes regular audiometric testing of staff that are exposed or have the potential to be exposed to excessive noise in the workplace.
- Implement a formal heat stress and UV management program. Where appropriate, heat exposure should be risk assessed using an appropriate methodology, such as the Australian Institute of Occupational Hygienists (AIOH) “Guide to Managing Heat Stress”.
- Implement a formal gas detector calibration, service and use program in accordance with the recommendations listed in Safety Alert no. 70; i.e. personal gas detectors are calibrated at an accredited test authority every 6 months in accordance AS/NZS 2290.3.
- Consider installing chemical containment bunds for bulk fuel, lubricants or coolants storage, at each generator facility to ensure that any spill or leak is prevented from contaminating the ground, entering a watercourse or a water drainage systems. Alternatively, use bulk storage devices that have an integral secondary containment.
- Consideration should be given to the inclusion of regular skin checks for workers required to spend prolonged periods in the sun as part of the site health surveillance program. Full skin examinations supported by total body photography and dermoscopy are also recommended every 6 months for individuals at high risk.
- Consideration should be given to a mandatory Q Fever vaccination program for its workers, and employing preventative measures (e.g., face masks, hand washing, controlled plant entry) for visitors who cannot provide documentary evidence of having received the vaccine.

4 References

1. **Workplace Health and Safety Queensland.** *Managing Noise and Preventing Hearing Loss at Work - Code of Practice.* Brisbane : The State of Queensland , 2021. PN12640.

2. **Australian Institue of Occupational Hygienists.** *A Guide to Managing Heat Stress.* Melbourne : AIOH, 2013.

3. **Cancer Council Australia.** Position statement - Early detection of skin cancer. *National Cancer Control Policy.* [Online] Cancer Council, January 2019. [Cited: 28 October 2020.] https://wiki.cancer.org.au/policy/Position_statement_-_Screening_and_early_detection_of_skin_cancer#_ga=2.265243270.820848525.1603846970-2019028115.1596687344.

4. **Standards Australia.** *The storage and handling of flammable and combusitble liquids.* Sydney, NSW 2001 : Standards Australia Ltd, PO Box 476, 2017. AS1940.

5. **Workplace Health and Safety Queensland.** *Placarding for storage of hazardous chemicals.* Brisbane, Queensland : Queensland Government, Office of Industrial Relations, 5 November 2018. PN10227 Version 5.

6. **Standards Australia / Standards New Zealand.** *Explosive atmospheres. Part 29.2: Gas detectors - Selection, installation, use and maintenance of detectors for flammable gases and oxygen.* Sydney NSW 2001 : SAI Global, GPO Box 476, 2016. AS/NZS 60079.29.2, IEC 60079-29-2, Ed.2.0 (2015).

7. **Standards Australia / Standards New Zealand.** *Electrical equipment for coal mine - Introduction, inspection and maintenance. Part 3: Gas detecting and monitroing equipment.* Sydney, NSW 2001 : Standards Australia, GPO Box 476, 2018. AS/NZS 2290.3.

8. **Petroleum & Gas Inspectorate.** *Importance of gas detection equipment maintenance and calibration.* Brisbane, QLD : Resources Safety & Health Queensland, 23 November 2016. Petroleum and gas Safety Alert no.70, Verision 1.